Case Study 6: Zimbabwe Climate Proofing Infrastructure and Diversifying Livelihoods in Zimbabwe

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1 Introduction

Climate change is a global problem requiring global responses, encompassing North and South, East and West, local and regional communities, the public and private sectors and industrialised and developing nations. Ranging from global, governmental negotiations to individual choices, a multiplicity of actions, reactions, range of human activities, projects and programmes affect, and combine to become, this issue. It should be mentioned at the outset, however, that the bulk of present trend climate changes have been shown to be stimulated by economic and social activities in the developed nations rather than the developing.

Zimbabwe lies in a tropical region with a limited and unreliable rainfall pattern, as shown in Figure 1. Zimbabwe is vulnerable to climate change principally through shifting rainfall and extreme events. Social, economic and political configurations affecting human settlements, agricultural patterns and natural resources such as water, vegetation and forestry, combine to make climate impacts a threat to the development of the country. Drought already affects water supplies, agriculture and access to food which impact negatively on basic health and survival. Zimbabwe is also vulnerable to having a perennially high number of malaria cases. Climate adaptation measures are required to reduce the negative economic and social impacts due to these factors, the main drivers of which are located in prevailing social, economic and political institutions and processes.

The history, lifestyle and economic foundation of Zimbabwe is rooted in and around land and land-use for agriculture. Because climate change could negatively impact this sector and thus the achievement of Zimbabwe's social and developmental goals, the country has a need to be more aware, concerned and informed about possible future climate changes and the effects on its people and economy.

In Zimbabwe's Initial National Communications under the United Nations Framework Convention on Climate Change (UNFCCC), likely impacts in Zimbabwe caused by present trends in climate change include:

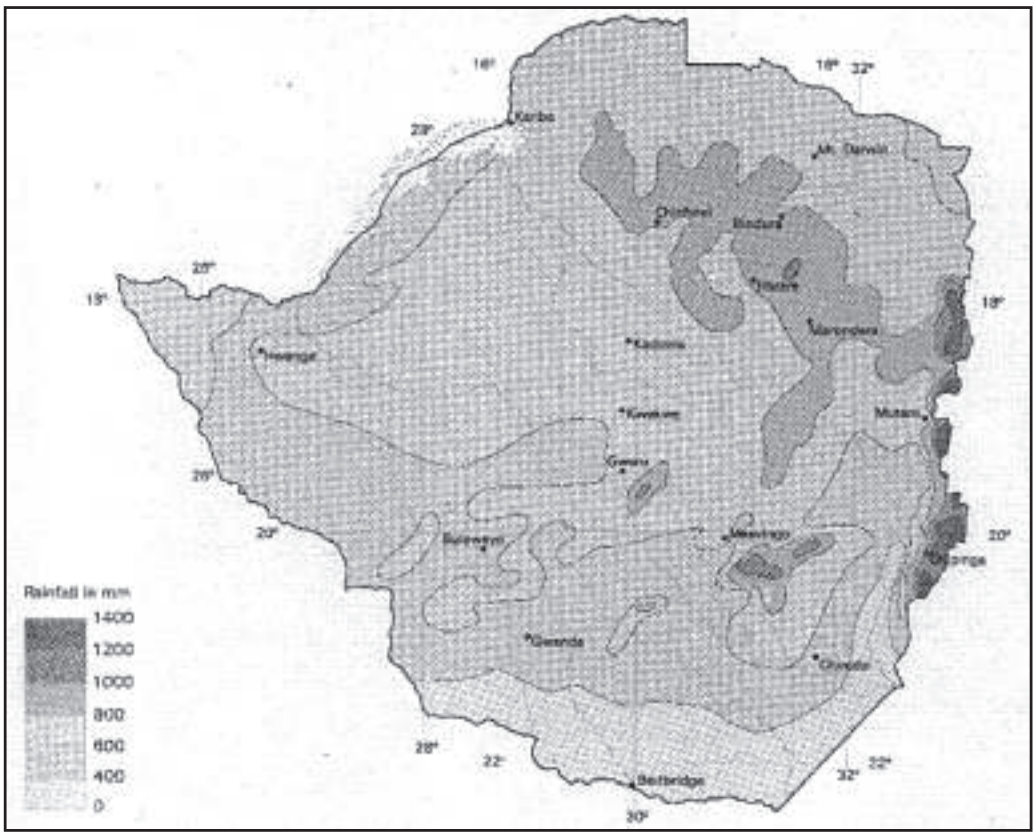
- increased water demand for irrigation due to the doubling of CO_2 concentration, resulting in increased evapotranspiration
- a decrease by approximately 30–40 per cent in water yield per dam
- worsening water supply/demand for both industrial and agricultural purposes
- reduced generation of electricity at Kariba hydropower station
- reduced biodiversity and inflow of tourists
- an impact on food security, especially maize, the staple food
- an impact on agriculture-based manufacturing industries
- an impact on health, especially malaria and nutrition.

Poverty is a main driver in causing unsustainable farming, grazing and wood-fuel gathering that have led to dryland degradation and desert encroachment. Climate change is likely to exacerbate these trends, as increasing temperatures will bring unpredictable precipitation patterns leading to more parched and

Table 1: Gross Domestic Product (GDP) 1996–2003

	1996	1997	1998	1999	2000	2001	2002	2003
Real GDP growth at market prices	9.7	1.6	0.7	–4.1	–6.8	–8.8	–13.0	–9.0
Real per capita GDP growth	7.8	0.1	–0.5	–4.9	–7.2	–8.9	–13.2	–9.3

Figure 1: Annual Rainfall Pattern in Zimbabwe



dry conditions and a possible increase in the frequency and intensity of extreme events such as cyclones. Reducing the vulnerability of dryland communities to more climate change will require measures that diversify livelihood options, reduce pressure on natural resources and restore and protect dryland ecosystems.

This case study examines how a small group of villages, the Tongwe Community Group, who live in the Mtetengwe area, Ward 4, Beitbridge district, have chosen livelihood diversification strategies as a way of increasing their resilience to the pattern of drought and unpredictable events, in this case a cyclone. The Tongwe Group was selected for the case study because their work with drought management and poverty alleviation is set against a background of drought and an extreme event, a cyclone, that washed away irrigation-related infrastructure that had not been "climate proofed"; situations that might be expected to be more common with climate change. Rather than trying to rebuild the irrigation infrastructure, the Tongwe Group chose to diversify income-generating livelihoods instead as a way of better coping with drought conditions. They also switched from maize,

Table 2: Key Development Indicators 1988–2003

	1988	1990	1995	2000	2002	2003
Social indicators						
Population (millions)	9.2	9.7	11.5	11.6	11.6	11.87
Population growth rate (%)	3.1	2.5	–	2.5	1.1	–
HIV prevalence (15–49 years) (%)	–	16.5	17.4	25.1	33.7	33.7
Life expectancy at birth, years	–	61	55	43	43	43
Economic indicators						
Real GDP growth rate (%)	7.5	7.0	0.2	–8.2	–14.5	–13.9
Per capita real GDP growth (%)	4.3	3.7	–1.3	–7.7	–14.7	–14.1
Consumer Price Index inflation (annual average, %)	7.0	12.4	22.6	55.9	133.2	525.85
Broad money M3 (% change)	24.1	21.1	30.0	59.9	164.8	420.9
Official exchange rate (Z$ to US$1)	0.51	0.38	8.70	46.5	55.00	824.00
Parity market exchange rate (Z$ to US$1)	NA	NA	NA	59.2	70.00	6 000
Budget deficit (excluding grants) as a percentage of GDP	–6.0	–5.3	–12.2	–24.1	–14.9	–11.5
Gross national savings (% of GDP)	19.1	15.7	20.3	11.5	3.1	–19.4
Gross national investment (% of GDP)	15.5	18.2	25.0	13.5	8.9	4.1
Net foreign direct investment (US$ million)	–	–12	98	16	23	5
Domestic debt (Z$ billion)	4.8	6.7	24.5	162.1	357.0	589.0
Domestic debt to GDP ratio (%)	32.3	31.2	39.1	52.0	36.4	14.9
External debt (US$ billion)	–	–	4.0	3.2	3.5	3.5
External payment arrears (US$ million)	–	–	290	471.1	1,460.0	1,628.0
Export growth (%)	17.0	15.2	14.4	–1.0	–11.8	–3.9
Import cover (months)	–	–	3.4	1.4	0.5	0.8
Social indicators II						
Employment growth rate (%)	4.3	–2.2	–1.8	–5.9	10.2	–
Structural unemployment (%)	–	–	–	–	>50	>50
Percentage of total population below the Food Poverty Line	–	–	57	–	69	>69
Percentage of total population below the Total Consumption Poverty Line	–	–	74	–	80	>80
Net primary enrolment ratio	–	–	81.9	–	92.6	–
Primary school completion rate (%)	76	–	76.1	75.1	–	–
Adult literacy rate (%)	–	80	86	88	–	–
Percentage of undernourished children under 5	–	12.7	16.9	13	–	–
Under-5 mortality rate (deaths per 1,000 live births)	–	59.9	76.9	102.1	–	–
Maternal mortality rate (deaths per 100,000 live births)	–	283	350	695	–	–
Births attended by skilled health personnel (%)	76	–	87	–	90	–
Rural population with access to safe water (%)	–	65	73	75	–	–
Rural population with access to safe sanitation (%)	–	48	56	58	–	–

which is difficult to grow in persistent drought conditions, to drought-tolerant and pest-resistant sorghum seed. A key part of their success lies in establishing new community institutions endowed with legal personality. These enable the community to receive, manage and utilise external funds with ease in a timely fashion without intermediaries. Because maize is a stable crop for over 95 per cent of Zimbabwe's 11 million people, the strategies used by the Tongwe Group may have a broader relevance within Zimbabwe and for other African countries.

Section 2 of this case study provides background

Figure 2: Main Centres of Population in Zimbabwe

information on Zimbabwe, on the expected impacts generated by climate models and on the political and institutional arrangements drawing on information provided from other sources (Moyo *et al.* 1993; Matarira *et al.* 1996; UNEP 2004; UNDP and GEF 2004). Section 3 sets outs the drought- and cyclone-related adaptation activities of the Tongwe Group. Section 4 sets out recommendations and conclusions about the wider significance of the case study.

2 Climate change and Zimbabwe

2.1 Key economic–political facts

Zimbabwe is a land-locked country with a total surface area of 39 million ha. It is located between 15° and 22° south latitude and 24° and 33° east latitude. Zimbabwe enjoys a pleasant subtropical climate with temperatures averaging 19°C in winter and 27° in summer. However, there are wide diurnal (daily) and location variations depending on latitude. There are two distinct seasons: a cool dry season from April to August and a hot wet season from October to March. The mean annual rainfall is 800 mm and varies according to topography and altitude. Seasonal droughts are common, particularly in the month of January.

Zimbabwe's economy has been in a steep decline since 1996, due to effects of political factors and actions taken by the government. Particularly hard hit were the sectors of agriculture, industry and tourism. Performance in all key sectors continued to deteriorate in 2002–3, with the agricultural sector down by more than 30 per cent, manufacturing by 40 per cent, mining by 15 per cent and tourism by at least 50 per cent. Structural unemployment is estimated at over 70 per cent and continues to rise. Inflation passed 600 per cent per annum by November 2004. Domestic debt rose from Z$162.1 billion in 2000 to Z$194.1 billion in 2001 and Z$346 billion in 2002. External debt stood at US$4.5 billion including arrears of over US$1.4 billion as at end of February 2003.

Real gross domestic product (GDP) growth

witnessed a significant decline from 9.7 per cent in 1996 to -13.0 per cent by the end of 2003.

The country's economic situation has been compounded by the erosive impact of the AIDS epidemic (discussed below), a polarised political environment and a series of droughts. The current economic conditions are associated with declines across a number of indicators of social well-being.

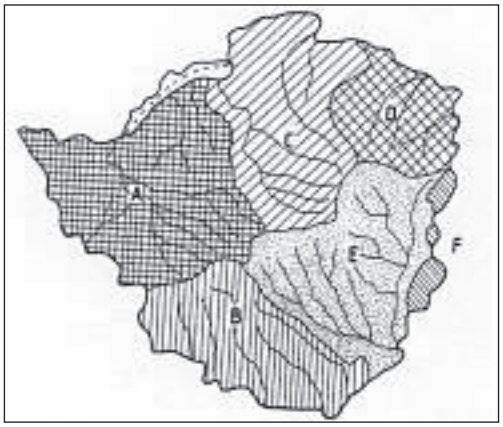
The 1998 *Zimbabwe State of Environment* concludes that due to lack of qualitative and quantitative data which shows trends over time, it has been difficult to show clear linkages between pressures and conditions of Zimbabwe's environment. Thus the availability of reliable data crucial to State of Environment reporting for people to be better informed and prepared to respond effectively, is lacking. Notwithstanding the shortcomings of reliable data, it is generally agreed that Zimbabwe's environment has suffered and will continue to suffer from land degradation and deterioration in many forms. The main reasons are that the will to enforce existing environmental policies and laws by relevant authorities is lacking. Also, the government has management problems compounded by severe fiscal restraints and compelling issues of priorities.

In Zimbabwe, the greatest contributors to environmental degradation have become poverty and growing inequalities due to the economic decline, business closures, unemployment and retrenchments. With well over half the population now living below the poverty datum line, risky sources of livelihood that are not friendly to the environment, such as gold panning and stream-bank cultivation, have been adopted.

Governmental reduction in the funding of essential social services and the adoption of cost-recovery measures for government services after the introduction of structural adjustment programmes have contributed to the dramatic economic decline. Purchasing power of the general population has been grossly eroded by hyper-inflation. The emergence of the new phenomenon of purchasing foreign currency on what is known as the parallel market – a legal, structured currency black market, illustrates the complexities and depths of the economic situation.

With 600 per cent hyperinflation taking its toll on the psyche, people have employed adaptation mechanisms. Engaging in urban cultivation to supplement wage incomes, part-time gold panning to cross-subsidise rising agricultural input costs, and various types of trading and bartering have become alternative sources of income and survival in an environment of vast business shut downs and unemployment. The creative, artistic and entrepreneurial talents of the Zimbabwean people remain a bright spot on the landscape.

Figure 3: Hydrological Zones



Additionally, though Zimbabwe is a country under targeted economic sanctions from the EU and the USA, there are some signs since 2003 that the decline may be slowing. The economy is market-based with control measures in place to protect the poor.

As reflected in Figure 2, on population, Zimbabwe had eight provinces and has now also included Harare and Bulawayo cities as provinces increasing the number to ten.

Political and decision-making structure

Zimbabwe is a unitary democratic republic with an elected as well as appointed parliament. The national legislature consists of House of Assembly with 150 members. Every five years, 120 are elected by universal adult suffrage. The remaining 30 include ten provincial governors, ten customary chiefs and ten others appointed by the President. The major functions of the parliament are to enact laws, supervise the government's administration, allocate taxes and address grievances by way of petition. The head of the government is the executive President. The Zimbabwe legal system is based on Roman–Dutch Law and the 1979 Lancaster House Constitution.

The country's ten administrative provinces are linked to the central government with each province having a resident minister. Each province is headed by a Governor politically appointed by the Executive President.

Table 3: Baseline and 2 x CO_2 Mean Annual Run-off of the Hydrological Zones (A to F)

Zone	Area (km^2)	Baseline		2 x CO_2	
		10^6 m^3	mm	10^6 m^3	mm
A	102,557	1,743	17	872	9
B	62,541	1,188	19	594	10
C	90,523	5,612	62	2,806	31
D	36,711	4,148	113	2,074	57
E	84,550	5,919	70	2,959	35
F	7,290	1,268	174	634	87
National	384,172	19,879	52	9,940	26

Socio-economic landscape

The social fabric of the country has been ravaged by the AIDS pandemic which casts a dark pall over the entire country. In Zimbabwe, AIDS kills over 2,000 people every week. A third of all pregnant mothers are HIV positive and at least one in every four adults is infected with the virus. After 1998, the life expectancy dropped from 60 years to 39 years, which has obvious and manifold implications not only for worker productivity but also for psychological well-being and untold stresses in social relations. Simple numerical losses added to losses of skilled and experienced workers, and accounting for those caring for others who are infected with AIDS, has led to greatly diminished industrial and agricultural capabilities which will continue for some time into the future, even if the economy recovers. In terms of current problems, AIDS in Zimbabwe, in Southern Africa particularly and in Africa overall, overshadows threats from climate change.

2.2 Scenario-derived potential impacts of climate change

By way of background, this section describes impacts for economic sectors derived from General Circulation Models (GCMs), which were used to simulate likely changes in temperature and precipitation as a result of the doubling of CO_2. The models and the potential impacts under various scenarios were then assessed for the following sectors: forestry, water resources, agriculture and health.

Forestry

The Goddard Institute for Space Sciences (GISS) model of 1982 was used to evaluate changes in forest cover due to climate change. The GISS predicts a global temperature rise of 4.2°C at 2 x CO_2 and an increase in precipitation of 11 per cent at current precipitation levels (Zimbabwe's Initial National Communication 1998). Under this scenario, the changes that take place are:

- Subtropical dry forest could become tropical dry forest
- Subtropical thorn woodland could become tropical dry forest
- The warm temperate moist forest in Nyanga is replaced by subtropical moist forest due to increased potential evaporation–transpiration
- Subtropical moist forest loses 3,220 km to tropical dry forest. The southern most portion of Zimbabwe degenerates into tropical thorn woodland.

Water resources

Of the three Global Climate Models – GISS, Geophysical Fluid Dynamics Laboratory (GFDL) and Canadian Climate Centre (CCC) – the CCC reasonably simulates current temperatures, particularly in the Gwayi, Odsi and Sebakwe catchments. Therefore, this model was used to develop both temperature and precipitation scenarios for the doubling of CO_2. Estimating water demand to the year 2075 was based on population projections and average growth rates in water usage from 1950 to 1995.

Rainfall run-off simulation for the doubling of CO_2 scenario showed that a 15–19 per cent decrease in rainfall and a 7.5–13 per cent increase in potential evaporation–transpiration will result in a 50 per cent decrease in run-off. The difference in climate change impact on run-off among the three representative catchments is considered as a 50 per

Table 4: Average Maize Yields Over 40 Seasons Under Different Planting Dates

Planting date and climate scenario	Average maize yield over 40 seasons (kg/ha^{-1})			
	Beitbridge	Masvingo	Gweru	Karoi
15 October				
Normal	738	3,006	3,006	3,727
CCCM (2 x CO_2)	514	3,493	5,011	2,634
GFDL (2 x CO_2)	1,640	3,097	5,446	2,940
1 November				
Normal	1,136	2,779	2,567	3,654
CCCM (2 x CO_2)	838	2,725	3,444	4,641
GFDL (2 x CO_2)	1,740	2,402	2,815	4,640
15 November				
Normal	514	2,592	2,507	3,531
CCCM (2 x CO_2)	1,092	58	3,444	3,512
GFDL (2 x CO_2)	1,422	47	2,815	3,507
1 December				
Normal	1,203	2,417	2,047	3,225
CCCM (2 x CO_2)	1,304	47	3,063	2,956
GDFL(2 x CO_2)	1,453	45	2,640	2,940
15 December				
Normal	1,213	2,339	1,121	3,143
CCCM (2 x CO_2)	713	43	770	41
GFDL (2 x CO_2)	725	40	735	41

CCCM: Carbon Cycle Modelling Group. GFDL: Geophysical Fluid Dynamics Laboratory.
Source: Matarira *et al*. (1996).

cent decrease; this was also assumed to be a reasonable estimate for the whole country.

The World Conservation Union (IUCN) estimates show that Zimbabwe's water supply to demand ratio is 0.89 negative with demand outstripping supply by 631 million cubic metres. The situation together with the threat of droughts makes it imperative that response mechanisms, including water conservation programmes be put in place. This is true for all sectors, including irrigation, rain-fed agriculture, industrial processes and concentrated human settlements.

A doubling of CO_2 would cause the rivers in the Eastern Highlands of Zimbabwe, that are today well watered and perennial, to develop flow regimes similar to those currently experienced in the dry regions, i.e. season rivers (see Table 3 and Figure 3).

Agriculture

Studies have been carried out to investigate the effects of climate change on agriculture in Zimbabwe. Matarira *et al*. (1996) used the CERES-MODEL (IBSNAT 1989, described in Zimbabwe's Initial National Communication) to simulate maize responses to climate change at four sites in four of the country's five natural regions. Maize was considered for the simulation because it constitutes the staple food crop of over 95 per cent of the country's population. Simulations were discrete, with the default initial soil water moisture set at the field capacity of the soils. Nitrogen stress and pests were not simulated. The cultivar simulated was R201, a short-season maize cultivar common in communal farming regions in the country. Various planting dates were tested. Two equilibrium climate scenarios were used, representing much larger changes in climate than are presumed to occur after 2050. This model was validated by means of local experiment crop data. Experimental data included types of cultivars, planting date, growth analysis, fertiliser application, harvesting date and final yield. Using global circulation models, the observed climate data were

Table 5: Impact of Climate Change on Lengths of Growing Seasons

Climate scenario and planting date	Average season length (days)[1] Beitbridge	Masvingo	Gweru	Karoi
Normal				
15 October	83	121	121	127
1 November	85	121	122	129
15 November	88	121	121	103
1 December	85	124	121	132
15 December	84	127	113	135
CCCM (2 x CO_2)				
15 October	77	101	110	105
1 November	79	101	107	108
15 November	78	101	103	208
1 December	78	102	104	109
15 December	83	102	112	109
GFDL (2 x CO_2)				
15 October	87	104	111	107
1 November	84	103	106	110
15 November	81	103	103	111
1 December	82	104	105	111
15 December	83	105	113	112

Source: Matarira *et al*. (1996).

modified to create climate change scenarios. The CCC model (Houghton *et al*.1990) and the GFDL (Boer *et al*. 1992) were used to establish the climate change scenarios for the vulnerability assessment. Subsequent sections describe the potential impacts as shown by the models for four districts in Zimbabwe, including Beitbridge, the areas of the case study (see Tables 4 and 5).

Human health

Both the Intergovernmental Panel on Climate Change (IPCC) and the World Health Organization (WHO) have raised concerns about potential adverse effects of climate change on human health. In Zimbabwe, investigations into the possible implications of climate change on human health have been limited. Reviews conducted reveal the complex nature of the problem where demographic changes, increase of malaria incidences, water-related health effects as well as changes in heat stress associated with temperature increases have been observed. Incidences of malaria usually reach a peak during the rainy season when temperatures are high and bodies of stagnant water are abundant. It is estimated that about one in every three people live in malaria risk areas.

In 1996, the incidence of malaria was very high after heavy rains and high temperatures throughout the country. About 1.4 million clinical cases were reported. The estimated deaths of 6,000 represented a major cause of national mortality.

2.3 Key institutions and policy processes

The climate change issue is a new concept in Zimbabwe, both in terms of its science and policy implications. The understanding of this subject and its scientific basis and relevance to Zimbabwe's economy – are mainly restricted to a few institutions and individuals exposed to the subject. It is not possible, therefore, that Zimbabwe would, at this stage, have a stated or fully considered national perspective on policies and measures to respond to climate change.

However, climate change activities and awareness in Zimbabwe have been growing since its participation at the Rio Earth Summit in 1992. Since then, various IPCC and Conference of Parties (COP) activities in Zimbabwe, including a number of studies, have encouraged limited national consultations and activities relevant to the UNFCCC. These consultations and activities, while not constituting stated

Table 6: Tongwe Ward 4 Population Distribution by Age

	(%)	No
0–11 months	3.6	510
1–4 years	13.2	1,869
Under 15 years	16.8	2,379
15 years and over	31.2	4,419
Antenatal	52.0	7,081
Expected deliveries	5.0	708
Family planning	4.0	566
New acceptors	8.0	1,132
Women of child-bearing age	23.0	3,257

government policy, give indications of Zimbabwe's national thinking on issues relating to climate change.

The Ministry of Environment and Tourism is the custodian of the UNFCCC in Zimbabwe. It takes the lead in climate negotiations and in domestic implementation processes. Following national consultations, the ministry established a National Steering Committee on Climate Change that draws from a cross-sectoral grouping of stakeholders. The committee reviews all national climate change positions that the country may take and acts as a deliberating body on new and emerging issues on climate change. To provide consistent facilitation of climate change activities, the ministry also established a Climate Change Office with a full-time coordinator and secretary. This office and the committee form the core institutional arrangement of climate change activities in the country.

Apart from government initiatives, climate change is being discussed by some organisations in the private sector. Industry associations, particularly the Confederation of Zimbabwe Industries, Environment Sub-committee, the Environment Forum of Zimbabwe, the Zimbabwe Investment Centre and the Indigenous Business Development Centre have begun to discuss mainstreaming of climate change issues into their environmental discussions. A number of non-governmental organisations (NGOs) provide technical expertise to support these discussions, which have tended to focus on mitigation analysis, inventories, desertification and impacts on water and agricultural production.

More technical and scientific research remains focused on traditional natural resources topics.

Table 7: Exchange Rate for Zimbabwe

Year	Zimbabwe $ to US$1
1999	37.95
2000	37.95
2001	55.00
2002	55.00
2003	824.00
2004	5400.00

Other key ministries relevant to climate change but which have not yet developed detailed analysis of climate change linkages include:

- Ministry of Energy and Power Development
- Ministry of Water Resources and Rural Development
- Ministry of Transport and Communications
- Ministry of Labour and Social Welfare
- Ministry of Local Government, Public Works and National Housing
- Ministry of Finance and Economic Development
- Ministry of Land and Rural Resettlement
- Ministry of Agriculture.

Poverty Reduction Strategy Papers (PRSPs) have not been developed for Zimbabwe, since the country owes money to the International Monetary Fund (IMF) and World Bank. However, with use of district and provincial development plans for sustainable development, a national action plan has been developed anchored on the three pillars for sustainable development: economic, social and environment. This plan arose in direct response to the World Summit on Sustainable Development held in South Africa 2002 and the Johannesburg Plan of Implementation. The National Development Plan on Sustainable Development is guided by the targets outlined within the eight Millennium Development Goals.

By including climate change issues in the 1996 review of environmental legislation, Zimbabwe has signalled its intent to incorporate climate change policies in its national development plans. However, like the rest of Africa, Zimbabwe is constrained by a lack of human, institutional and financial resources to put appropriate measures in place which can respond to the challenges presented by climate change.

3 Drought and cyclones: adaptation by the Tongwe community

3.1 Tongwe's climate, people and economy

Tongwe Ward (also known as Ward 4) is approximately 569 km from Harare. It lies about 50 km southeast of Beitbridge. The Tongwe Ward has a population of 14,162 people, with a growth rate of 3.3 per cent. Ward 4 comprises five villages namely:

1. Tongwe village: the subject of this case study
2. Penemena village: gardening and goat keeping
3. Mugaladivha: soap making and gardening
4. Jompembe: gardening and HIV/AIDS Orphans Project
5. Matshiloni: gardening and livestock fattening.

Over 90 per cent of the total population of the Beitbridge district in which Tongwe Ward is located comprises people of Sotho and Venda origin. Other distinct groups include the Shangani in the east and the Lemba to the west. In all five villages, development interventions are aimed at enhancing income-generating livelihoods. In this case study we focus on Tongwe village only. Table 6 gives the population breakdown according to age.

In Ward 4, family planning is accepted as a means of regulating the size of families.

3.2 Vegetation and water resources

The vegetation of Beitbridge district is described and mapped in Zimbabwe's Initial National Communication. Three vegetation types are identified in the district:

1. The *Terminalia sericea* deciduous tree savannah
2. *Colophospermum mopane* tree savannah on gneissic soils (good tree for edible caterpillar worms)
3. Acacia shrubs including the following species: *Boscia Foetida, Gewia Flora, Dichrostachys Cinerea.*

There are four major river basins in Beitbridge district: the Limpopo, Bubi, Mzingwane and Shashe flow only during the rainy season (about five months) and they are dry for most of the year except for isolated pools along the riverbed. Water, both surface and underground, is probably one of the most limiting factors to the economy of the district.

3.3 Household economy and wealth

Cattle, donkeys, goats and sheep are the mainstay of the economy in the communal areas of Beitbridge district. The most significant characteristic for categorising wealth of households is that of livestock size and ownership, with cattle being the key variable. Although cattle are occasionally slaughtered for meat, goats and sheep are bred primarily for meat. Goats and sheep are also sold to raise small amounts of cash (the source of what can be termed petty cash). On the other hand, until 1994, donkeys were bred solely for draught power and transport purposes. They are used primarily for drawing "scotch carts" which are the major means of transport in the area. Donkeys have almost replaced cattle completely as the source of draught power for ploughing crop fields. In 1994, NGOs from Zambia and Mozambique started buying donkeys from the Beitbridge area for use as draught power in their respective countries. Therefore the monetary value (see Table 7) for donkeys increased from Z$100 to over Z$800 in 1997 and to Z$1,000,000 or even more in 2004.

3.4 Community-led livelihood diversification

This case study examines how a small group of villagers who live in the Mtetengwe area, Ward 4, Beitbridge district, came together to form the Tongwe Development Association (TDA) to pursue livelihood diversification strategies as a way of increasing their resilience to droughts and unpredictable cyclonic extreme events.

TDA was established in 1998 in Tongwe village as an informal community-based organisation comprising approximately 100 people from 60 households. The group of people comprising TDA came together in the context of an irrigation project supported by the Africa 2000 international effort to supply water and sanitation to African countries. The Africa 2000 programme was supported by the United Nations Development Programme (UNDP) and the project included significant strengthening of an existing dam to provide irrigation for Beitbridge. The grant for the irrigation project, received in 1999, resulted in the establishment of a revolving fund which was managed by the Tongwe community with little outside input, initially for consultation and works related to the irrigation project.

The dam was built, a little late, but in accordance with project documents. Unfortunately, due to an unexpected cyclone in 2000 (Cyclone Eline), the dam was destroyed almost as soon as it was completed. This meant that the original benefits the irrigation project was meant to confer did not

materialise. Instead of seeking to rebuild the dam, TDA decided to use the small amount of funds left over from the original irrigation project to invest in livelihood diversification strategies. It is the adaptation of the dam's destruction through community-directed income-generating new livelihood strategies that is of wider interest here. From 2000 onwards, the leftover funds were used for investments in stimulating income-generating activities which have worked well. These schemes pursued by TDA have potential for replication into other parts of the country where similar conditions prevail. Decentralising management of the leftover funds to the community allowed them to benefit from the failure of the initial project, illustrating that where communities are given the opportunity to act on their initiative and have additional resources, they "go for it" and are able to make decisions that enhance livelihoods in unexpected ways. The formation of a legal association by the community enabled them to open a bank account to directly manage and account for the funds.

The original proposal for building the dam arose because affected households approached Africa 2000 to assist them in establishing an irrigation scheme. The cutting of shrubs to fence gardens had destroyed the community's environment, resulting in land degradation and soil erosion.

With assistance from UNDP, the community were taught water conservation strategies and water catchment area management, as most of their rivers fed the Limpopo. Beitbridge district is in Natural Ecological Region V, a region prone to droughts. The proposal to extend the existing Tongwe dam was planned to establish a 20 ha irrigation scheme. Each household would get one-third of a hectare for intensive cropping for their own use and for marketing in order to generate income.

Initially the Beitbridge Rural District Council assisted with coordination of the project while TDA was being formed. By the time this was done, Zimbabwe was experiencing a hyperinflationary environment and quotations relating to goods supply were only valid for eight hours. As a result, the construction of the dam took a long time to complete. In addition, council procedures took a long time to approve purchase of orders and by the time they were approved, the goods cost more. This hindered progress and the process had to start all over again. To circumvent these obstacles the TDA decided to open its own bank account to allow donors to credit funds directly into their account.

The establishment of the irrigation scheme was delayed. Although some parts had been completed, everything was washed away including the dam spillway because of floods caused by Cyclone Eline, which occurred on 22 February 2000. This devastating tropical cyclone with strong winds affected the eastern and southern parts of the country. It happened when some parts of the country, particularly the main river basins, were experiencing life-threatening floods – in the Save river basin in Manicaland, the Limpopo river in the southern provinces of Matebeleland South and Masvingo. The main tributaries of the Limpopo, including the Shashe and Bubi rivers, were affected.

In these areas, flooding was experienced between 4–6 February. During this season, some very arid areas in Matebeleland South, Masvingo and Manicaland received uncharacteristically high rainfall. When the cyclone occurred it attacked an already fragile environment causing landslides and flooding. Communications systems were destroyed by strong winds, bridges and some dwellings were damaged and swept away. The effect of the floods and the cyclone left some people without access to the rest of the country.

After the cyclone TDA, backed by the support of the community, informed Africa 2000 that their irrigation scheme together with the dam had been washed away and that they would like to use the remainder of the money (US$18,000) to set up a revolving fund to enable the groups to embark on income-generating activities for livelihoods provision. Africa 2000 agreed and sent the request to the National Selection Committee of Africa 2000 who concurred but proposed the amount be reduced to US$8,000 (approximately Z$500,000 at that time).

Most of this money was then used by the TDA to construct wells to provide water for gardening purposes. Some men, women and youths opted to rear small livestock, such as goats and sheep. Other members of the group decided to buy millet and sorghum to engage in seed production for the area, as seeds available on the black market were not genuine seeds. Some groups ventured into dairy cattle intending to sell the milk to the community. These activities were chosen by the community and thus reflected their own livelihood priorities.

Having realised that seeds were unavailable in the ward, the TDA embarked on seed production. In 2004 one of the Tongwe community groups

sowed 1 kg of sorghum seed and yielded 50 kg, of which part was sold and the remainder kept for the group's future use. However, during the same year from March to August, they did not realise any harvest due to an invasion of locusts.

The Lanmdzweri area comprises nine members under Kraal Head Mabhutara. The members are mostly women. Each member contributed two sheep in 2001 and started with 18 sheep increasing to 28 sheep in 2002. In 2003, nine sheep died due to drought, leaving 19. In 2004 one was sold for Z$350 and the money was shared so that they could pay school fees for their children.

The Mvelaphanda, an eight-member group of women in the area of Headman Khethani started pig production in 2000 but this failed to take off due to a shortage of stock feed. This group then decided to borrow Z$20,000 to buy eight goats at Z$2,000 each, with the balance being allocated towards maintenance of the goats. By 2002, the goats had reproduced to 16 and the group sold four to repay the amount borrowed and shared the profits among each family. In 2003, the goats increased to 24 and the group sold two at Z$200,000 each. In 2004, the group sold four at Z$400,000 each and are now left with 20 goats. The membership is now six due to the death of two members. The death of members of the group has created difficulties, but despite this they managed to pay back their borrowed money, indicating that rearing goats was a sound investment.

The Lothu Biogas Project in the area of Headman Thabara has 11 members, mainly women. In 2002, a female group member went to a workshop in Gewene where the people from the Insiza community told her about biogas digesters. This resulted in the group embarking on a biogas project, which is environmentally friendly and curbs flue gas-related diseases, and helps the women to save time since it minimises the chore of fuelwood fetching.

To summarise, the revolving fund was paid back after one year. A small interest of 25 per cent per annum, minimal compared with banks charging more than 200 per cent per annum, was accrued. The members of the TDA selected a person to compile a monthly report on the performance of all the projects and update TDA together with the Rural District Council on progress, enabling these institutions to take corrective measures when necessary.

3.5 Mutubuki Chitenderano Integrated Project in Gutu district

Mutubuki Chitenderano Integrated Project has a membership of 405 men, women and youths, and one primary and one secondary school. The communities in this area experienced water shortage problems and drying up of the Mutubuki wetland, their main source of water. The wetland was degraded due to human and livestock impacts. The key project objectives were drought mitigation through the protection and sound management of the Mutubuki wetland.

With a project objective to mitigate drought through protection and sound management, donors were approached with assistance from the Gutu Rural District Council. Funds were sourced through UNDP funding for the National Action Programme (NAP). NAP provided funds for capacity building. The community formed the Mutubuki Chitenderano Development Association (MCDA) and in 1999, the wetland was demarcated and fenced off to protect it from livestock trampling and grazing. The *vlei*, which was almost barren, was rehabilitated by planting grass. The MCDA established the following committees:

1. Management committee
2. Advisory committee
3. Garden committee
4. Electrification committee.

In 2000, the MCDA constructed two small dams for the purpose of harvesting water from the wetland. In the same year, women groups started gardening using the available water.

From 2001–4 the electrification of the village including the two schools and township was achieved with assistance from the rural electrification agency. Heifer International donated 90 heifers and four bulls. About 41 heifers were calved, benefiting other families in the community. In the long run, the whole community benefited and continue to benefit from the heifer scheme, which was premised on a run-on and pass-on scheme once the heifer had calved. With assistance of EU Micro projects secured in 2002, Chitenderano primary and secondary schools have been electrified, as have the Mushai and Chingombe business centres. Some 20 households have also been electrified and it is planned that the remaining households will be electrified giving adequate time for woodland regeneration and water catchments area management.

4 Lessons learnt

These initiatives demonstrate that communities have considerable experience in adapting to climate variability and deploy sophisticated livelihood diversification strategies if obstacles (lack of legal status, bank accounts) are removed and additional resources provided. The key lessons for the major actors involved in development are outlined below.

4.1 Communities

The Tongwe community realised on their own that they should not cut down trees but rather rehabilitate the degraded areas in order to prevent siltation of rivers and dams and to improve biodiversity. The community learnt that they could save time as well as financial resources when purchasing goods if money came directly to them as a legal entity with their own bank account. Finally, the Mutubuki community learnt that by managing their resources well they could improve and sustain their livelihoods. They understood that the drying of the wetland is caused by human beings and livestock. Through hard work, they can have electricity in their homesteads and by managing their resources well, they can attract more donor funding.

4.2 Regional and national policy makers

Policy makers have realised that by decentralising authority to the local–traditional leaders, such as chiefs and headmen, the natural resources of the country will be better protected than if determined externally on the basis of someone else's priorities.

4.3 Financial interventions

Financial interventions, where possible, should go directly to communities who should form legal entities or through organisations with grassroots connections that practice bottom-up approaches.

4.4 The outcome for the Tongwe community

The initial outcome was uncompleted irrigation schemes washed away together with the Tongwe dam spillway. In the reformulation of this project and the redirection, many income-generating activities were embarked on and owned by the communities as the initiators providing better sources of livelihoods and availability of seeds for the community at reasonable cost. The people who embarked on the projects have improved their living standards and can indulge in diet variations, such as vegetables or meat, when they so desire. Through the formation of the TDA, they have also built social capital and have acted to correct gender-based inequalities and hardships.

4.5 The outcome for Mutubuki Chitenderano integrated project

There was improved natural resources management and electrified homesteads, development of business centres and schools. Through the sale of vegetables and goats the community have better living standards. Water flow improved and people downstream started receiving water from which they had not benefited from for ten years. The biogas project is gender sensitive as it saves women and girls large amounts of time looking for firewood for use in the house. Methane gas (biogas) is clean and prevents respiratory diseases and eye infections caused by smoke from fuelwood. The effluent is used as fertiliser to boost vegetables growing in the garden.

Importantly, there was a legacy of cooperative efforts setting up, managing and viewing projects with continuing success and with a very good chance of continuing for ten or more years. This indeed is a measure of achievement of sustainable development.

4.6 Future climate research

Based on this case study and other projects undertaken in Zimbabwe, research needs to find ways of:

- Identifying and mapping vulnerable areas and regions to climate change in Zimbabwe
- Documenting indigenous knowledge systems on coping mechanisms to climate variability by the communities
- Scaling up best practices by communities on adaptation to climate variability
- Communicating information on weather forecasting to rural communities as adaptation strategies to climate variability
- Finding resistance to drugs of vector-borne disease and ways of eradicating them
- Formulating policies and programmes to address the impact of climate change with a bottom-up approach and the associated socio-economic benefits
- Mainstreaming adaptation into country developmental programmes

- Marketing and costing of diversified drought-resistant crops.

5 Conclusion

The institutions and policy processes mentioned in Section 2 could be tasked to review ministries to promote the mainstreaming of climate change. Crucially, urban or district council budgets should be lobbied to mainstream adaptation in all national developmental programmes. An important lesson is that all new infrastructure should be "climate proofed", i.e. designed to confer benefits taking into account potential climate change impacts which are unlikely to resemble the past. Climate proofing may mean ensuring building standards are set for the construction of dams, bridges and roads and guarantee infrastructural development.

When communities are empowered and given the opportunity to manage their natural resources, they will do it effectively and efficiently using their traditional knowledge. To raise the heights of local communities to have the self-confidence to select, assimilate and adapt external knowledge to their environments rather than being overwhelmed and rendered intellectually dependent and subservient, is the prerequisite for sustainable development. Considerable effort is required to adapt development knowledge to local conditions, and culture and communities need to be empowered through, and within, this process.

To allow local communities to play an active role in influencing/participating in policy formulation which directly affects their livelihoods, is crucial. Ownership by the true stakeholders needs to be promoted because the reason for effectiveness of policies is not just some "technical" correctness but ownership, a participative process of democratic discussion and consensus building. The degree of ownership is more likely to be greater when those within the community itself develop the strategies and policies; when the communities themselves are in the drivers' seat, only then will sustainable development be leap-frogged.

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